



## UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE  
United States Patent and Trademark Office  
Address: COMMISSIONER FOR PATENTS  
P.O. Box 1450  
Alexandria, Virginia 22313-1450  
www.uspto.gov

## NOTICE OF ALLOWANCE AND FEE(S) DUE

22801

7590

09/09/2009

LEE & HAYES, PLLC  
601 W. RIVERSIDE AVENUE  
SUITE 1400  
SPOKANE, WA 99201

EXAMINER

ERB, NATHAN

ART UNIT

PAPER NUMBER

3628

DATE MAILED: 09/09/2009

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/782,687	02/19/2004	Kamal Jain	MS1-3951US	4582

TITLE OF INVENTION: SYSTEMS AND METHODS FOR MODELING APPROXIMATE MARKET EQUILIBRIA

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	\$1510	\$300	\$0	\$1810	12/09/2009

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. **PROSECUTION ON THE MERITS IS CLOSED.** THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN **THREE MONTHS** FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. **THIS STATUTORY PERIOD CANNOT BE EXTENDED.** SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

## HOW TO REPLY TO THIS NOTICE:

I. Review the SMALL ENTITY status shown above.

If the SMALL ENTITY is shown as YES, verify your current SMALL ENTITY status:

A. If the status is the same, pay the TOTAL FEE(S) DUE shown above.

B. If the status above is to be removed, check box 5b on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and twice the amount of the ISSUE FEE shown above, or

If the SMALL ENTITY is shown as NO:

A. Pay TOTAL FEE(S) DUE shown above, or

B. If applicant claimed SMALL ENTITY status before, or is now claiming SMALL ENTITY status, check box 5a on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and 1/2 the ISSUE FEE shown above.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

**IMPORTANT REMINDER:** Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.

# **PART B - FEE(S) TRANSMITTAL**

**Complete and send this form, together with applicable fee(s), to:** Mail **Mail Stop ISSUE FEE**  
**Commissioner for Patents**  
**P.O. Box 1450**  
**Alexandria, Virginia 22313-1450**  
**or Fax** **(571)-273-2885**

**INSTRUCTIONS:** This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

22801 7590 09/09/2009

LEE & HAYES, PLLC  
 601 W. RIVERSIDE AVENUE  
 SUITE 1400  
 SPOKANE, WA 99201

## **Certificate of Mailing or Transmission**

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

(Depositor's name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/782,687	02/19/2004	Kamal Jain	MS1-3951US	4582

TITLE OF INVENTION: SYSTEMS AND METHODS FOR MODELING APPROXIMATE MARKET EQUILIBRIA

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	\$1510	\$300	\$0	\$1810	12/09/2009

EXAMINER	ART UNIT	CLASS-SUBCLASS
ERB, NATHAN	3628	705-400000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

- ☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.  
☐ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. Use of a **Customer Number is required.**

2. For printing on the patent front page, list

- (1) the names of up to 3 registered patent attorneys or agents OR, alternatively, 1 \_\_\_\_\_  
 (2) the name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed. 2 \_\_\_\_\_  
 3 \_\_\_\_\_

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE

(B) RESIDENCE: (CITY AND STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent): ☐ Individual ☐ Corporation or other private group entity ☐ Government

4a. The following fee(s) are submitted:

- ☐ Issue Fee  
☐ Publication Fee (No small entity discount permitted)  
☐ Advance Order - # of Copies \_\_\_\_\_

4b. Payment of Fee(s): (Please first reuply any previously paid issue fee shown above)

- ☐ A check is enclosed.  
☐ Payment by credit card. Form PTO-2038 is attached.  
☐ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment, to Deposit Account Number \_\_\_\_\_ (enclose an extra copy of this form).

5. Change in Entity Status (from status indicated above)

- ☐ a. Applicant claims SMALL ENTITY status. See 37 CFR 1.27. ☐ b. Applicant is no longer claiming SMALL ENTITY status. See 37 CFR 1.27(g)(2).

NOTE: The Issue Fee and Publication Fee (if required) will not be accepted from anyone other than the applicant; a registered attorney or agent; or the assignee or other party in interest as shown by the records of the United States Patent and Trademark Office.

Authorized Signature \_\_\_\_\_ Date \_\_\_\_\_  
 Typed or printed name \_\_\_\_\_ Registration No. \_\_\_\_\_

This collection of information is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.



# UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE  
United States Patent and Trademark Office  
Address: COMMISSIONER FOR PATENTS  
P.O. Box 1450  
Alexandria, Virginia 22313-1450  
[www.uspto.gov](http://www.uspto.gov)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/782,687	02/19/2004	Kamal Jain	MS1-3951US	4582
22801	7590	09/09/2009	EXAMINER	
LEE & HAYES, PLLC 601 W. RIVERSIDE AVENUE SUITE 1400 SPOKANE, WA 99201			ERB, NATHAN	
			ART UNIT	PAPER NUMBER
			3628	

DATE MAILED: 09/09/2009

## Determination of Patent Term Adjustment under 35 U.S.C. 154 (b) (application filed on or after May 29, 2000)

The Patent Term Adjustment to date is 733 day(s). If the issue fee is paid on the date that is three months after the mailing date of this notice and the patent issues on the Tuesday before the date that is 28 weeks (six and a half months) after the mailing date of this notice, the Patent Term Adjustment will be 733 day(s).

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (<http://pair.uspto.gov>).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

# Notice of Allowability

Application No.

10/782,687

Examiner

NATHAN ERB

Applicant(s)

JAIN ET AL

Art Unit

3628

**-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--**

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to the response filed on July 13, 2009.
2. ☒ The allowed claim(s) is/are 1,3-6,11,12,14-16,20,23,25 and 26.
3. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).  
a) ☐ All b) ☐ Some\* c) ☐ None of the:  
1. ☐ Certified copies of the priority documents have been received.  
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.  
3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

\* Certified copies not received: \_\_\_\_\_.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.  
**THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.**

4. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.
5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.  
(a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached  
1) ☐ hereto or 2) ☐ to Paper No./Mail Date \_\_\_\_\_.  
(b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date \_\_\_\_\_.  
**Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).**
6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

## Attachment(s)

1. ☒ Notice of References Cited (PTO-892)
2. ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3. ☐ Information Disclosure Statements (PTO/SB/08),  
Paper No./Mail Date \_\_\_\_\_
4. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
5. ☐ Notice of Informal Patent Application
6. ☐ Interview Summary (PTO-413),  
Paper No./Mail Date \_\_\_\_\_
7. ☒ Examiner's Amendment/Comment
8. ☒ Examiner's Statement of Reasons for Allowance
9. ☐ Other \_\_\_\_\_.

### **EXAMINER'S AMENDMENT**

An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

Authorization for this examiner's amendment was given in telephone calls with Attorney Dale Mohlenhoff on August 28, 2009.

Claims 1, 3, 12, 14, and 23 of the application have been amended as follows:

1. (currently amended) A computer-readable medium having computer-readable instructions embedded therein which, when executed by a computer, cause the computer to implement a method for facilitating determination of equilibrium values for a market system, the method for facilitating determination of equilibrium values for the market system comprising:

receiving a number of types of goods  $m$ , a number of buyers  $(n + 1)$ , an initial amount of each good that each buyer possesses, and a utility function for each of buyers  $i = 1, \dots, n$ , for the market system;

applying a polynomial-time approximation method to the received data to generate an approximate equilibrium price vector for the market system, the polynomial-time approximation method comprising:

initializing with an arbitrary first price vector  $p$ ;

setting a variable,  $D$ , to represent a maximum deficiency for the first price vector  $p$ ;

constructing an instance,  $M_p$ , of the market system, wherein constructing the instance,  $M_p$ , of the market system comprises:

providing  $m$  types of goods and  $(n + 1)$  buyers;

setting, for  $i = 1, \dots, n$ , a utility of buyer  $i$  for the goods as to be calculated from the corresponding utility function;

establishing the budget of buyers  $i = 1, \dots, n$ , according to:

$$e_i := \sum_{j=1}^m p_j w_j^i, \quad e_i := \sum_{j=1}^m p_j w_j^i$$

wherein  $e_i$  is the budget of buyer  $i$ ,  $[[p]]_i$  is the

price of good  $j$  in the first price vector, and  $w_j^i$  is equal to an initial amount of good  $j$  that buyer  $i$  possesses;

setting, for  $i = (n + 1)$ , a utility of buyer  $i$  for each of goods  $[[j]] = 1, \dots, m$ , as equal to  $p_j$ ; and

establishing the budget of buyer  $i = (n + 1)$  as

$$e_{(n+1)} := D;$$

executing a DPSV algorithm on the instance,  $M_p$ ,

starting from the first price vector  $p$  and increasing prices until equilibrium is reached, and outputting a second price vector  $(p')$  via execution of the DPSV algorithm;

setting a budget  $e_i'$  for each buyer  $i$  with respect to the second price vector  $(p')$  according to:

$$[[e_i' := \sum_{j=1}^m p_j' w_j^i; ]]$$

$$e_i' := \sum_{j=1}^m p_j' w_j^i;$$


---

determining if a budget ratio  $[(e_i'/e_i)]/[(e_j'/e_j)]$  for each buyer  $i$  satisfies a budget ratio constraint of:

$$e_i'/e_i \leq 1 + \varepsilon,$$

wherein  $\varepsilon$  represents a desired amount of approximation;

identifying the second price vector  $(p')$  when the budget ratio constraint is satisfied for every buyer  $i$  as the approximate equilibrium price vector for the market system; and

iterating the polynomial-time approximation method with the first price vector  $p$  set equal to the second price vector  $(p')$ , instead of an arbitrary price vector, when the budget ratio constraint is unsatisfied, until the budget ratio constraint is satisfied;



outputting the approximate equilibrium price vector to a computer monitor display; and

setting prices based on the approximate equilibrium price vector.

3. (currently amended) The computer-readable medium of claim 1, wherein the approximate equilibrium price vector comprises an approximate equilibrium price vector,  $p^*$ , that produces, in conjunction with a bundle of goods for each buyer  $i$ , an  $\mathcal{E}$ -approximate equilibrium for the market system such that:

for every good  $j$ :

$$(1 - \mathcal{E}) \sum_{i=1}^n w_j^i \leq \sum_{i=1}^n x_j^i \leq \sum_{i=1}^n w_j^i;$$

wherein  $x_j^i$  is the number of good  $j$  in the bundle of goods of buyer  $i$ ; and

for all  $i$ , a utility,  $\sum_{j=1}^m u_{ij} x_{j-1}^i$  of buyer  $i$  is equal to or greater than  $(1 - \epsilon)$  times a value of an optimum solution of a maximization of the utility function for the buyer  $i$  subject to:

$$\sum_{j=1}^m p_j^* x_j^i \leq \sum_{j=1}^m p_j^* w_j^i ;$$

wherein  $m$  represents the number of types of goods and  $w_j^i$  indicates the initial amount of good  $j$  that buyer  $i$  possesses.

12. (currently amended) A computer-implemented method for facilitating determination of equilibrium values for a market system, comprising:

receiving, by a computing system, a number of types of goods  $m$ , a number of buyers  $(n + 1)$ , an initial amount of each good that each buyer possesses, and a utility function for each of buyers  $i = 1, \dots, n$ , for the market system;

applying, by the computing system, a polynomial-time approximation method to the received data to generate an approximate equilibrium price vector for the market system, the polynomial-time approximation method comprising:

initializing with an arbitrary first price vector  $p$ ;

setting a variable,  $D$ , to represent a maximum deficiency for the first price vector  $p$ ;

constructing an instance,  $M_p$ , of the market system, wherein constructing the instance,  $M_p$ , of the market system comprises:

providing  $m$  types of goods and  $(n + 1)$  buyers;

setting, for  $i = 1, \dots, n$ , a utility of buyer  $i$  for the goods as to be calculated from the corresponding utility function;

establishing the budget of buyers  $i =$

$e_i := \sum_{j=1}^m p_j w_j^i$ ,  $1, \dots, n$ , according to:

$$e_i := \sum_{j=1}^m p_j w_j^i,$$

wherein  $[e_i]$  is the budget of buyer  $i$ ,  $p_j$  is the

price of good  $j$  in the first price vector, and  $w_j^i$  is equal to an initial amount of good  $j$  that buyer  $i$  possesses;

setting, for  $i = (n + 1)$ , a utility of buyer  $i$  for each of goods  $j = 1, \dots, m$ , as equal to  $p_j$ ; and

establishing the budget of buyer  $i = (n + 1)$  as  $e_{(n+1)}$

$:= D$ ;

executing a DPSV algorithm on the instance,  $M_p$ ,

starting from the first price vector  $p$  and increasing prices until equilibrium is reached, and outputting a second price vector  $(p')$ ;

setting a budget  $e_i'$  for each buyer  $i$  with respect to the second price vector  $(p')$  according to:

$$e_i' := \sum_{j=1}^m p_j' w_j^i;$$

determining if a budget ratio ( $e_i'/e_i$ ) for each buyer  $i$  satisfies a budget ratio constraint of:

$$e_i'/e_i \leq 1 + \varepsilon,$$

wherein  $\varepsilon$  represents a desired amount of approximation;

identifying the second price vector ( $p'$ ) when the budget ratio constraint is satisfied for every buyer  $i$  as the approximate equilibrium price vector for the market system; and

iterating the polynomial-time approximation method with the first price vector  $p$  set equal to the second price vector ( $p'$ ), instead of an arbitrary price vector, when the budget ratio constraint is unsatisfied, until the budget ratio constraint is satisfied;

outputting the approximate equilibrium price vector to a computer monitor display; and

setting prices based on the approximate equilibrium price vector.

14. (currently amended) The computer-implemented method for facilitating determination of equilibrium values for the market system of claim 12, wherein the approximate equilibrium price vector comprises an approximate equilibrium price vector,  $p^*$ , that produces, in conjunction with a bundle of goods for each buyer  $i$ , an  $\mathcal{E}$ -approximate equilibrium for the market system such that:

for every good  $j$ :

$$(1 - \mathcal{E}) \sum_{i=1}^n w_j^i \leq \sum_{i=1}^n x_j^i \leq \sum_{i=1}^n w_j^i;$$

wherein  $x_j^i$  is the number of good  $j$  in the bundle of goods of buyer  $i$ ; and

$$\text{for all } i, \text{ a utility, } \left[ \sum_{j=1}^m u_{ij} x_j^i \right] \underline{\sum_{j=1}^m u_{ij} x_j^i}, \text{ of buyer } i \text{ is}$$

equal to or greater than  $(1 - \mathcal{E})$  times a value of an optimum

solution of a maximization of the utility function for the buyer  $i$   
subject to:

$$\sum_{j=1}^m p_j^* x_j^i \leq \sum_{j=1}^m p_j^* w_j^i ;$$

wherein  $m$  represents the number of types of goods and  
 $w_j^i$  indicates the initial amount of good  $j$  that buyer  $i$  possesses.

23. (currently amended) A computer system that facilitates  
determination of equilibrium values for a market system,  
comprising:

a processor; and

a memory connected to the processor;

wherein the processor and the memory perform the steps of:

receiving a number of types of goods  $m$ , a number of  
buyers  $(n + 1)$ , an initial amount of each good that each  
buyer possesses, and a utility function for each of buyers  $i =$   
 $1, \dots, n$ , for the market system;

applying a polynomial-time approximation method to the received data to generate an approximate equilibrium price vector for the market system, the polynomial-time approximation method comprising:

initializing with an arbitrary first price vector  $p$ ;

setting a variable,  $D$ , to represent a maximum deficiency for the first price vector  $p$ ;

constructing an instance,  $M_p$ , of the market system, wherein constructing the instance  $M_p$  of the market system comprises:

providing  $m$  types of goods and  $(n + 1)$  buyers;

setting, for  $i = 1, \dots, n$ , a utility of buyer  $i$  for the goods as to be calculated from the corresponding utility function;

establishing the budget of buyers  $i = 1, \dots, n$ , according to:



$$e_i := \sum_{j=1}^m p_j w_j^i, \quad e_i := \sum_{j=1}^m p_j w_j^i,$$

wherein  $[[e_i]]_{\underline{e}_i}$  is the budget of buyer  $i$ ,  $[[p_j]]_{\underline{p}_j}$  is the price of good  $j$  in the first price vector, and  $w_j^i$  is equal to an initial amount of good  $j$  that buyer  $i$  possesses;

setting, for  $i = (n + 1)$ , a utility of buyer  $i$  for each of goods  $j = 1, \dots, m$ , as equal to  $p_j$ ; and

establishing the budget of buyer  $i = (n + 1)$  as

$$e_{(n+1)} := D;$$

executing a DPSV algorithm on the instance,  $M_p$ , starting from the first price vector  $p$  and increasing prices until equilibrium is reached, and outputting a second price vector  $(p')$ ;

setting a budget  $e_i'$  for each buyer  $i$  with respect to the second price vector  $(p')$  according to:

$$e_i' := \sum_{j=1}^m p_j' w_j^i;$$

determining if a budget ratio ( $e_i'/e_i$ ) for each buyer  $i$  satisfies a budget ratio constraint of:

$$e_i'/e_i \leq 1 + \varepsilon,$$

wherein  $\varepsilon$  represents a desired amount of approximation;

identifying the second price vector ( $p'$ ) when the budget ratio constraint is satisfied for every buyer  $i$  as the approximate equilibrium price vector for the market system; and

iterating the polynomial-time approximation method with the first price vector  $p$  set equal to the second price vector ( $p'$ ), instead of an arbitrary price vector, when the budget ratio constraint is unsatisfied, until the budget ratio constraint is satisfied;

outputting the approximate equilibrium price vector to a computer monitor display; and  
setting prices based on the approximate equilibrium price vector.

\*\*\*\*\*

Any inquiry concerning this communication or earlier communications from the examiner should be directed to NATHAN ERB whose telephone number is (571) 272-7606. The examiner can normally be reached on M-F 8:30 AM - 5:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, John Hayes can be reached on (571) 272-6708. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Application/Control Number: 10/782,687  
Art Unit: 3628

Page 17

NATHAN ERB  
Examiner  
Art Unit 3628

nhe

***Allowable Subject Matter***

1. Claims 1, 3-6, 11-12, 14-16, 20, 23, and 25-26 are allowed over the prior art of record.

2. The following is an examiner's statement of reasons for allowance:

The closest prior art of record is Yakov, U.S. Patent Application Publication No. US 2004/0111308 A1, and Devanur, Nikhil R., Papadimitriou, Christos H., Saberi, Amin, and Vazirani, Vijay V., "Market Equilibrium Via a Primal-Dual-Type Algorithm," focs, pp. 389, The 43rd Annual IEEE Symposium on Foundations of Computer Science (FOCS'02), 2002.

Yakov discloses a computer system which allocates resources and determines pricing.

Devanur discloses a polynomial-time algorithm for determining market equilibrium.

As per claims 1, 12, and 23, the closest prior art of record taken either individually or in combination with other prior art of record fails to teach or suggest:

applying, by the computing system, a polynomial-time approximation method to the received data to generate an approximate equilibrium price vector for the market system, the polynomial-time approximation method comprising:

initializing with an arbitrary first price vector  $p$ ;

setting a variable,  $D$ , to represent a maximum deficiency for the first price vector  $p$ ;

constructing an instance,  $M_p$ , of the market system, wherein constructing the instance,  $M_p$ , of the market system comprises:

providing  $m$  types of goods and  $(n + 1)$  buyers;

setting, for  $i = 1, \dots, n$ , a utility of buyer  $i$  for the goods as to be calculated from the corresponding utility function;

establishing the budget of buyers  $i =$

$e_i := \sum_{j=1}^m p_j w_j^i$ ,  $1, \dots, n$ , according to:

$$e_i := \sum_{j=1}^m p_j w_j^i,$$

wherein  $e_i$  is the budget of buyer  $i$ ,  $p_j$  is the price of good  $j$  in the first price vector, and  $w_j^i$  is equal to an initial amount of good  $j$  that buyer  $i$  possesses;

setting, for  $i = (n + 1)$ , a utility of buyer  $i$  for each of goods  $j = 1, \dots, m$ , as equal to  $p_j$ ; and

establishing the budget of buyer  $i = (n + 1)$  as  $e_{(n+1)} := D$ ;

executing a DPSV algorithm on the instance,  $M_p$ , starting from the first\_price vector  $p$  and increasing prices until equilibrium is reached, and outputting a second price vector ( $p'$ );

setting a budget  $e_i'$  for each buyer  $i$  with respect to the second price vector ( $p'$ ) according to:

$$e_i' := \sum_{j=1}^m p_j' w_j^i;$$

determining if a budget ratio ( $e_i'/e_i$ ) for each buyer  $i$  satisfies a budget ratio constraint of:

$$e_i'/e_i \leq 1 + \varepsilon,$$

wherein  $\varepsilon$  represents a desired amount of approximation;

identifying the second price vector ( $p'$ ) when the budget ratio constraint is satisfied for every buyer  $i$  as the approximate equilibrium price vector for the market system; and

iterating the polynomial-time approximation method with the first price vector  $p$  set equal to the second price vector ( $p'$ ), instead of an arbitrary price vector, when the budget ratio constraint is unsatisfied, until the budget ratio constraint is satisfied.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

3. Any inquiry concerning this communication or earlier communications from the examiner should be directed to NATHAN ERB whose telephone number is (571) 272-7606. The examiner can normally be reached on M-F 8:30 AM - 5:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, John Hayes can be reached on (571) 272-6708. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.



Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

NATHAN ERB  
Examiner  
Art Unit 3628

nhe

/JOHN W HAYES/  
Supervisory Patent Examiner, Art Unit 3628